

# ChemTalk



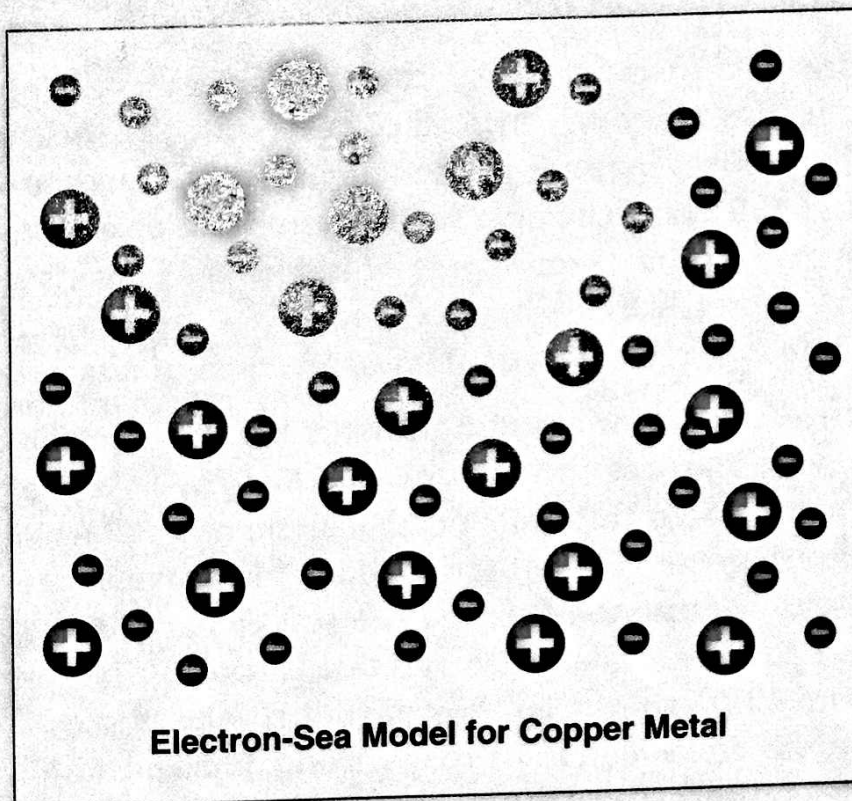
## METALS, NONMETALS, AND METALLOIDS

In this activity you investigated specific properties of materials. You then used your observations to classify a material as a **metal** or a **nonmetal**. Metals have **luster**. They exhibit **conductivity**. They conduct electricity and heat. They are malleable and **ductile** and they are often relatively **reactive**. Many metals form a compound on their surface that results from reactions with air. When you scrape or sand a piece of

metal you are removing that coating of metal compound. Sometimes that natural coating can prevent further reacting and will preserve the metal underneath.

Looking at the drawing at the right, you can see that in solid copper metal the centers of the copper atoms are in fixed locations but they are surrounded by a sea of electrons. If an electric circuit is set up, the electrons are free to move. This is the basis

of the metallic property of electrical conductivity.



Electron-Sea Model for Copper Metal

### Chem Words

**metal:** classes of materials that exhibit the properties of conductivity, malleability, reactivity, and ductility. Metal elements readily lose electrons to form positive ions.

**nonmetal:** elements that do not exhibit the properties of conductivity, malleability, reactivity, and ductility. These elements tend to form negative ions. The oxides of the elements are acidic.

**luster:** the reflection of light from the surface of a material described by its quality and intensity.

**conductivity:** the property of transmitting heat and electricity.

**elasticity:** the property of a material to resist deformation and return to its normal size or shape after a force has been applied to it.

**reactivity:** a property that describes how readily a material will react with other materials.





### Chem Words

**oxidation:** the process of a substance losing one or more electrons.

**alloy:** a substance that has metal characteristics and consists of two or more different elements.

### Checking Up

1. List five properties of metals and five properties of nonmetals.
2. Why is it important to prevent the oxidation of metals used in construction?
3. Explain the meaning of an alloy.
4. Why are alloys used?

On the other hand, silicon dioxide is an amorphous solid; you know it as glass. In glass, electrons are fixed into position and are held tightly by each atom due to covalent bonding (sharing of electrons) between silicon and oxygen atoms. Since the electrons are not mobile, the glass does not conduct an electric current like copper metal does. Glass is a nonconductor of electricity.

Preserving metal and preventing its reaction with some of the components in the air is a major task. When metals react with oxygen in the air it is called **oxidation**. This type of reaction is what happens when things rust. Preventing rust is important. While a metal like steel is very strong and makes excellent building material, once it rusts it loses all strength and flakes away. Millions of structures, tools, and vehicles are made primarily of metal. Preventing rust (also called corrosion) is essential if they are to remain in good operating condition. In order to prevent oxidation, metal surfaces can be painted, coated, or combined with another metal to make them less reactive.

Nonmetals have characteristics that are generally opposite to those of metals in every way. Instead of being lustrous, their surfaces are dull in appearance. They are nonconductive, brittle, and nonductile. Over the past 150 years, chemists have developed a chart for classifying and organizing the chemical elements. Elements are classified as metals and as nonmetals. Some other elements are called metalloids. They share some characteristics of metals and some of nonmetals.

Brass and solder are not elements but they are still classified as metals. They are commonly called **alloys**. Alloys are materials that contain more than one metal element and still maintain the characteristic properties of metals. Many metals are not practically useful because they may be too soft and are hard to work with. Gold is a good example of a metal that is too soft for jewelers to work with so they make an alloy of gold, silver, and copper. The alloy is harder and will hold its shape. Iron combined with chromium, nickel, and carbon makes the alloy called steel. This gives it the strength that it needs in construction. The brass that you investigated contains 67% copper and 33% zinc. Solder contains 67% lead and 33% tin. Alloys are classified as metal solutions and if they are uniformly mixed then they are homogeneous mixtures called solution alloys.